Fire Suppression for Museums and Other Cultural Institutions

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Recent Museum Fires - Butantan Institute

- Herpetological Collection
  - 77,000 snakes
  - 450,000 spiders & scorpions
- Most important type collections of Brazilian snakes
- 80% of collections destroyed
- No sprinklers or fire alarm
Recent Museum Fires - New Delhi Museum of Natural History
Recent Museum Fires - Museu Nacional, Brazil
Recent Museum Fires - Museu Nacional, Brazil
This Will Never Happen To Us...Right?

• On average, 70 museum fires a year in the US
• Easy to ignore because of everyday hazards
• Reasons museum fires can become catastrophic
  • Absence of fire sprinklers or other suppression
  • A delay in fire discovery
  • Lack of compartmentation of a building
  • Combustibility of collections
Museum Fire Myths

• Noncombustible construction = fire safe
• “We’ll be fine, the fire department is next door”
• Strong fire prevention programs are enough
• Automatic sprinklers are just as damaging as fire
Fire Protection Strategy

Goals/Objectives:

- Protect People
- Protect Building
- Protect Collections
- Protect Mission/Business Continuity

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Building & Fire Codes DO NOT provide for protection of collections

Building & Fire Codes DO NOT provide for continued operations

Building & Fire Codes DO provide the BARE MINIMUM for Life Safety
Fire Protection Strategies

• Prevention
  • Dedicated spaces for hazardous operations
  • Managing combustibles
  • Controlling ignition sources
• Fire Protection Systems
  • Fire suppression
  • Fire detection
• Containment
  • Fire-rated barriers
  • Opening protective
Automatic Fire Suppression

Fire Suppression Systems:

- Total flooding gaseous systems
- Hypoxic air systems
- Water mist systems
- Sprinkler systems
Fire Suppression - Sprinkler Systems

Sprinkler Systems

Benefits of Sprinkler Protection:
• Automatic response - no waiting for fire dept.
• Sprinklers are heat activated
• Fraction of the volume of water released compared to hose streams
• Low maintenance
• Extremely reliable
Fire Suppression - Sprinkler Systems

Why the Smithsonian is protected with sprinklers:

• Reliability
• Effective fire control
• Economical
• Relatively low maintenance

Today, approx. 90% of Smithsonian spaces are protected by sprinklers.
Smithsonian Castle Fire - 1865
Fire Suppression - Sprinkler Systems

Wet Pipe Sprinkler System
• Pipes are filled with water
• No delay in water application
• Lowest maintenance
• Most reliable
Fire Suppression - Sprinkler Systems

Dry Pipe System
• Pipes are filled with air
• Cold areas
• Sprinkler activation allows air pressure to drop and valve to open
• Release of air, followed by water
• Delay = air release time
• Higher maintenance
Fire Suppression - Sprinkler Systems

Preaction System

- Pipes are filled with air
- Water-sensitive areas
- Water release controlled by smoke detection
- Delay = dependent on system
- Highest maintenance
Fire Suppression Systems

Other Types of Suppression Systems

- Water Mist Systems
- Clean Agent Systems
- Hypoxic Air Systems
Suppression Systems - Water Mist

Water Mist Systems:
- Utilizes water as a mist for fire control
- Much less water than sprinklers
- Smaller diameter piping
- Heat activated heads
- Custom design for the space/hazard
- High pressure pumps, piping and fittings
- Higher installation and maintenance costs than sprinklers
Suppression Systems - Water Mist
Suppression Systems: Clean Agent

Total Flooding Clean Agent Systems

• Control fire by cooling, chemically interrupting pyrolysis, reducing the oxygen concentration
• Agents: FM200, Novec, Inergen, OXEO

Advantages:
• Completely clean - no clean-up or damage
• Fast response/suppression
Disadvantages:

- High installation and maintenance cost
- Requires a tightly enclosed space
- Complex - dependent on fire detection system, dampers, doors, and many other components
- Environmental Impact - some agents are ozone depleters
Suppression Systems - Hypoxic Air

Utilizes compressors and a molecular filter to reduce oxygen levels to ~14% 

Advantages:
• Prevents fires from starting
• No clean-up
• Reduced degradation of collections

Disadvantages:
• Very expensive and specialized
• Requires an enclosed, tight space
• Maintenance intensive
Fire Suppression - Fire Extinguishers

- Many different types
- You usually see the red dry chemical ones
- Research by Colonial Williamsburg to determine which to use on collections
- Water mist appears to be the least damaging to most collection materials
Challenges - Retrofitting Sprinklers into Heritage Buildings

Special Care for Heritage Buildings

- Consider historic elements and aesthetics
- Use experienced architects and installers
- Identify and utilize building shafts, ceiling cavities, and other features to conceal pipe
- Conceal piping behind crown molding
- Consider copper pipe in exposed areas
- Paint piping to match surroundings
- Concealed heads, factory painted to match
Considerations and Lessons Learned

Planning & Design

• Take into account needed infrastructure

• Careful design is key to success
  • Experienced architect & sprinkler designer
  • Fully investigate existing conditions

• Emphasize system quality, consider:
  • Avoiding mains in sensitive areas such as collection storage
  • Quality of materials - thicker wall pipe, threaded fittings in lieu of mechanical
  • PTFE (Teflon Tape) in lieu of lubricants
Considerations and Lessons Learned

Construction/Installation:

• Be selective in hiring a sprinkler contractor
  • Experience with museums/historic buildings
  • Technicians with sprinkler certifications (NICET)
• Incorporate precautions into the contract
  • Physical protection for building features and collections
  • Pretest with air for areas highly vulnerable to water damage
Considerations and Lessons Learned

Construction/Installation:
• Shop drawings, product submittals and hydraulic calculation reviewed and approved

Conduct periodic inspections to verify:
• Plans are being followed
• Historic fabric protected
• Approved materials and methods used
• Satisfactory workmanship
Considerations and Lessons Learned

Construction/Installation: Final Acceptance

• Final inspection - examine all piping, fittings, heads, valves, drains, signage
• Verify accuracy of as-built drawings
• Pressure test for 200 psi for 2 hours, check each joint for leaks
• Ensure proper number and type of spare heads
Considerations and Lessons Learned

Maintenance & Reliability

• Inspections, testing and maintenance for the life of the system is key
• NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems
• Also, educate staff about sprinklers
Challenges - Changing Attitudes

Steps to Addressing Sprinkler Concerns

Educate management and staff on:

• Fire risk vs risk of water damage
• Make it real - examples of museum fires
• Understand how sprinkler systems work
• Reliability of sprinklers
• Flow rates:
  • sprinkler ~ 80 - 180 lpm
  • fire hose ~ 950 lpm
Resources:

Smithsonian Fire Protection & Life Safety Design Manual includes:
- Fire Protection Systems Design Criteria
- Collections Storage Guidelines
- Exhibit Fire Protection and Life Safety Guide
- Available on the web at:

Resources: Codes and Standards for Cultural Properties

* free access to NFPA codes available at: https://www.nfpa.org/Codes-and-Standards/All-Codes-and-Standards/Free-access

**NFPA 909**
- Cultural Properties
  - Protection of Cultural Resource Properties, Museums, Libraries, and Places of Worship
  - Refers to NFPA 914 for historic structures

**NFPA 914**
- Historic Buildings
  - Code for Fire Protection of Historic Structures

**NFPA 101**
- Life Safety
  - Section 43.10 Historic Buildings
  - As they relate to Repair, Modification, Renovation Reconstruction and change of occupancy classification

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Thank You!

Questions?

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